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ABSTRACT

Research identified and evaluated the level of applied mathematics and science used in selected trade and industrial (T&I) subjects taught in the Kentucky Vocational Education System. The random sample was composed of 52 programs: 21 carpentry, 20 electricity/electronics, and 11 machine shop. The 96 math content items that were identified as representing 11 courses in the field of mathematics were structured into a general survey form along with appropriate descriptive information. The overall response rate was 51.9 percent. Each returned survey was tallied by content item and subtotaled by subject/course area. All responses were grouped by T&I area and combined in an overall for comparison. Percentages were calculated on each content item, on each math subject, and on the overall. (Five tables covering 22 pages display these results.) All three T&I areas exceeded the 50 percent level, which was accepted as significant instructional involvement, in the Fundamental Math course. Carpentry and machine shop covered over 50 percent of general math and geometry content items, electricity/electronics covered 61.76 percent of all algebra topics, and machine shop covered 57.89 percent of geometry content items. (The instrument is appended.) (YLB)

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FINAL REPORT

"APPLIED MATH & SCIENCE LEVELS UTILIZED IN SELECTED TRADE & INDUSTRIAL VOCATIONAL EDUCATION"

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TABLE OF CONTENT

Introduction 1

Review of Literature 2

Method and Procedure 3

Research Findings & Results 7

Recommendations & Conclusions 31

LIST OF TABLES

POPULATION OF SELECTED TRADE & INDUSTRIAL PROGRAMS 5

MATH CONTENT ITEM SELECTION BY GRADE LEVEL 6

RANDOM SAMPLE RESPONSE RATE 8

CARPENTRY RESULTS 9

ELECTRICITY/ELECTRONICS RESULTS 14

MACHINE SHOP RESULTS 19

OVERALL RESULTS 24

RESPONSE RATE FOR INDIVIDUAL MATH SUBJECT/COURSES BY T & I PROGRAM AREA 29

RESPONSE RATE FOR CONTENT ITEMS OF MATH SUBJECT/ COURSE BY T & I PROGRAM AREA 30

INTRODUCTION

Our youngsters need to be exposed as early as possible to science, math, and technology. Unless we begin now to motivate and equip them to pursue scientific and technological careers, the shortages will persist. The national lesson sputnik taught us in 1957 should still serve us.

Caspar Weinberger
Secretary of Defense

The importance of adequate skills in math and its application for today's work force cannot be over emphasized and extends well beyond scientific and technical fields. In an increasingly technological world, there are fewer and fewer jobs where such skills are not needed.

Sheila Pfafflin
Manager, ATT

There is a great interest today in the concept of "Basic" education among educators and the public in general. Quite often the term Basic is defined as involvement in or with the hard disciplines of Mathematics and/or Science. There have been several reports generated in this subject recently ranging from national to state & local studies. Most noticeable would be the report entitled "A Nation at Risk", authored by a committee under the direction of the United States Department o Education.

These reports seem to indicate a general weakness of our students' competencies (skills) in the basics of math and science comprehension, application, and interpretation. Little attention has been given in these efforts to identify and evaluate the current levels of math and science utilized in Vocational Education programs. It is therefore the intent of the research reported herein to identify and evaluate the level of applied mathematics and science utilized in selected Trade & Industrial subjects taught in the Kentucky Vocational Education system.

REVIEW OF LITERATURE

A literature review was undertaken in order to draw a better focus upon the subject of this study. Two computer searches of national data bases were conducted. The first search was of the ERIC data base, while the second included EDRS. The ERIC search identified only 10 articles which utilized descriptors common to this study, while the second search produced fewer citations. Neither computer search was accepted as successful in identifying existing work/research in this area.

A library search was undertaken through the Greater Cincinnati Library Consortium. It, too, did not produce a significant number of existing work in the area of math and science equivalence between vocational education and public high school.

Given the outcomes of the two literature searches described above, the researcher concluded that this area represented a relatively untouched concern in educational research.

The only significant work identified was that of Dr. Michael Dyrenfurth, Professor at the University of Missouri - Columbia. Dr. Dyrenfurth published an article entitled, "State Trends in Graduate Requirements" in the January, 1985, issue of VocEd. This article described his findings from a survey he made to all the state directors of vocational education. The report listed the current graduate requirements in each state and the areas where vocational education was used to satisfy said requirements. Dr. Dyrenfurth's research did establish "the most obviously pressing edge of the reform movement increased high school graduate requirements in mathematics ..." (VocEd, 1985,p.43). The research did not identify any significant level of vocational education involvement in graduate requirements.

Given the findings of the literature review, or lack of findings, the following objectives were set for this study.

- o Analyze and identify Trade & Industrial program areas that would act as the basics for Vocational Education.
- o Identify existing instruments to identify the current level of applied math & science utilization in selected Trade & Industrial programs.
- o Profile existing and emerging high school math and science program competencies.
- o Conduct an analysis of selected Trade & Industrial programs to determine current applied math & science utilization.
- o Analyze Vocational Education survey findings in relationship to general math & science skills.

METHOD AND PROCEDURE

Population and Sample

The spectrum of vocational educations' offerings at the secondary level was reviewed in order to identify appropriate subject areas for use in the research. Due to the inherent use of math and science in Trade and Industrial subjects (hereafter known as T & I), this division of vocational education was identified as the primary focus of the study. Within the T & I division three subject areas (programs) were further identified: Carpentry, Electricity/Electronics (E/E), Machine Shop. It was decided that these three subject areas of T & I adequately represented vocational education and would serve the need for generalization at a later date.

A general population of the three program areas of Carpentry, Electricity/Electronics, and Machine Shop was identified by use of the 1984/85 Directory of Vocational Education. The project attempted to identify programs in the three areas for all 15 vocational education regions in Kentucky (see Table 1). A total of 104 programs were sighted as the research population; 39 for carpentry, 42 for E/E, and 23 for machine shop.

A random sample of this population was taken for use in this research study. The sample was composed of 52 programs; 21 from carpentry, 20 from E/E, and 11 from machine shop. Each sample from the T & I population resembled approximatly 50% of the total (see Table 1).

Instrument

Given the lack of completed research on this topic and, therefore, the lack of readily available instruments, the research project director initiated a survey developmental effort. This effort was undertaken in order to identify math and science content and to structure that content into an appropriated instrument for use in the study.

The researcher utilized the Program of Studies for Kentucky School, Grades K - 12, July 1984 edition, Educational Bulletin Vol. LII No. 1, in the effort to identify course subject levels and content items for the instrument. At this point in the study a decision was made to concentrate on the field of Mathematics. This choice was made with the belief that math content would be easier to qualify and lend itself to a better data base establishment for future such studies.

In this regard, 96 math content items were identified representing 11 courses in the field of mathematics taught in Kentucky public high schools (see Table 2). The 96 content items were structured into a general survey form along with appropriate descriptive information (see appendix A). The structure was designed to solicit the instructional involvement in each item and attempts to gain a sense of the instructional time spent on each item. The T & I teacher could respond that the item was addressed through a "related" course/program used for support of his/her subject. It was explained that this related instruction must be a direct result of a student's enrollment in the T & I program. The survey also asked for a listing of the books, pamphlets, handouts, etc. used in instruction.

TABLE 1

POPULATION OF SELECTED TRADE & INDUSTRIAL PROGRAMS

REGIONS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	TOTAL
T & I AREAS																
CARPENTRY	6	3	2	4	4	2	2	0	6	0	3	3	1	1	2	39
E/E	5	4	3	4	1	5	3	0	6	0	4	3	0	1	3	42
MACHINE SHOP	4	3	1	2	1	4	0	0	0	0	2	1	0	1	4	23
TOTAL	15	10	6	10	6	11	5	0	12	0	9	7	1	3	9	104

TABLE 2

MATH CONTENT ITEM SELECTION BY GRADE LEVEL

COURSE		GRADE LEVEL	CREDIT	No. ITEMS
FUNDAMENTAL MATH	#2705	9	1	14
GENERAL MATH I	#2706	9-10	1	
GENERAL MATH II	#2709	10-12	1	8
PRE ALGEBRA	#2718	8	0	3
INTRO ALGEBRA I	#2720	8-10	1	7
INTRO ALGEBRA II	#2721	9-10	1	7
ALGEBRA	#2710	9-10	1	4
ALGEBRA II	#2711	10-12	1	13
INDUSTRIAL GEOMETRY	#2722	10-12	1	9
GEOMETRY	#2712	9-11	1	10
TRIGONOMETRY	#2713	--	1/2	8
MATH FUNCTIONS	#2704	11-12	1	13
TOTAL				96

Survey Procedure

An initial mailing was made to the sampling of 52 programs. This mailing included; cover letter describing the research effort and purpose, survey form with directions, and self addressed stamped envelope. Approximately five weeks later a second mailing was made to the sample group as a follow-up. The second mailing included; an additional letter describing the importance of their help, a copy of the orginial cover letter, and a survey form (see appendix B). The results of this procedure are given in Table 3. An overall response rate of 51.9% was obtained.

RESEARCH FINDINGS & RESULTS

Each returned survey was tallied by content item and subtotaled by subject/course area. All responses were grouped by T & I area and combined in an Overall for comparison. Percentages were calculated on each content item, on each math subject, and on the Overall. These results are displayed in tables 4 through 9.

TABLE 3

RANDOM SAMPLE RESPONSE RATE

T & I AREAS	SAMPLE SIZE	RESPONSE COUNT	PERCENTAGE RATE
CARPENTRY	21	8	38%
E/E	20	9	45%
MACHINE SHOP	11	10	90%
TOTAL	52	27	51.9%

TABLE 4

CARPENTRY

TOPIC

Fundamental Math	INVOLVEMENT			ITEM RESPONSE RATE			
CONTENT ITEMS	YES	NO	RELATE	Y %	N %	RE %	TOTAL
basic integer math	6	1	1	75.000%	12.500%	12.500%	8
prime factorization	5	3	1	55.556%	33.333%	11.111%	9
greatest common divis	7	1	0	87.500%	12.500%	0.000%	8
fractions	8	0	0	100.000%	0.000%	0.000%	8
decimals	8	0	0	100.000%	0.000%	0.000%	8
rational & irrational numbers	3	5	0	37.500%	62.500%	0.000%	8
least common multiple	5	3	0	62.500%	37.500%	0.000%	8
proportions	7	1	0	87.500%	12.500%	0.000%	8
percentage	7	1	0	87.500%	12.500%	0.000%	8
interest	4	4	0	50.000%	50.000%	0.000%	8
metric system	1	6	1	12.500%	75.000%	12.500%	8
conversion within a system	3	5	0	37.500%	62.500%	0.000%	8
area of simple plane	7	1	0	87.500%	12.500%	0.000%	8
volume of simple solids	5	3	0	62.500%	37.500%	0.000%	8
SUB TOTAL	76	34	3	67.257%	30.088%	2.655%	113

TOPIC

General Math	INVOLVEMENT			ITEM RESPONSE RATE			
CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL %
metric system	3	4	1	37.500%	50.000%	12.500%	8
shop mathematics	7	1	0	87.500%	12.500%	0.000%	8
elementary business math	3	5	0	37.500%	62.500%	0.000%	8
simple geometric construction	5	3	0	62.500%	37.500%	0.000%	8

TABLE 4 CON'T

reading & const-ructing graphs	3	5	0	37.500%	62.500%	0.000%	8
rectangular coordinat	3	4	1	37.500%	50.000%	12.500%	8
indirect measurment	2	5	1	25.000%	62.500%	12.500%	8
elementary probabilit	1	7	0	12.500%	87.500%	0.000%	8
SUB TOTAL	27	34	3	42.188%	53.125%	4.688%	64

TOPIC

Algebra — INVOLVEMENT — ITEM RESPONSE RATE

CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
meaning of variable	0	7	2	0.000%	77.778%	22.222%	9
use of variable in formula	0	6	2	0.000%	75.000%	25.000%	8
use of variable in applied situation	1	6	1	12.500%	75.000%	12.500%	8
number systems	1	7	0	12.500%	87.500%	0.000%	8
number theory	1	7	0	12.500%	87.500%	0.000%	8
symbols	2	6	0	25.000%	75.000%	0.000%	8
algebraic expressions	3	5	0	37.500%	62.500%	0.000%	8
equations	4	4	0	50.000%	50.000%	0.000%	8
inequalities	1	6	0	14.286%	85.714%	0.000%	7
polynomials (add,sub., multip.,divid)	3	5	0	37.500%	62.500%	0.000%	8
rea. number systems	1	7	0	12.500%	87.500%	0.000%	8
relations & functions	2	6	0	25.000%	75.000%	0.000%	8
exponents	2	6	0	25.000%	75.000%	0.000%	8
arithmetic of radical expressions	1	7	0	12.500%	87.500%	0.000%	8
factoring polynomials	1	7	0	12.500%	87.500%	0.000%	8
system of equations	2	6	0	25.000%	75.000%	0.000%	8
quadratic equations	1	7	0	12.500%	87.500%	0.000%	8
graphs	1	7	0	12.500%	87.500%	0.000%	8
positive & negative numbers	1	7	0	12.500%	87.500%	0.000%	8

mathematical sentence	3	5	0	37.500%	62.500%	0.000%	8
linear equations: one and two variables	1	7	0	12.500%	87.500%	0.000%	8
algebraic fractions	1	7	0	12.500%	87.500%	0.000%	8
exponents & radicals	1	7	0	12.500%	87.500%	0.000%	8
simultaneous equations & matrices	1	7	0	12.500%	87.500%	0.000%	8
sets & equations	1	7	0	12.500%	87.500%	0.000%	8
functions & relations	2	6	0	25.000%	75.000%	0.000%	8
algebraic functions	2	6	0	25.000%	75.000%	0.000%	8
exponential & logarithmic functions	1	7	0	12.500%	87.500%	0.000%	8
trigonometric function of angles	2	6	0	25.000%	75.000%	0.000%	8
trigonometric function of real numbers	2	6	0	25.000%	75.000%	0.000%	8
analytic geometry	1	7	0	12.500%	87.500%	0.000%	8
conic sections	1	7	0	12.500%	87.500%	0.000%	8
sequences & series	1	7	0	12.500%	87.500%	0.000%	8
Binomial Theorem	1	7	0	12.500%	87.500%	0.000%	8
SUB TOTAL	49	218	5	18.015%	80.147%	1.838%	272

TOPIC

Geometry	INVOLVEMENT			ITEM RESPONSE RATE			
CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
points	4	4	0	50.000%	50.000%	0.000%	8
lines	4	4	0	50.000%	50.000%	0.000%	8
planes	4	4	0	50.000%	50.000%	0.000%	8
planes figures	4	4	0	50.000%	50.000%	0.000%	8
area & perimeter of plane figures	4	4	0	50.000%	50.000%	0.000%	8
congruence	1	7	0	12.500%	87.500%	0.000%	8
similarity	2	6	0	25.000%	75.000%	0.000%	8

TABLE 4 CON'T

volume & surface area of solids	4	4	0	50.000%	50.000%	0.000%	8
construction & measurement	5	3	0	62.500%	37.500%	0.000%	8
inductive & deductive reasoning	2	6	0	25.000%	75.000%	0.000%	8
angles	6	1	0	85.714%	14.286%	0.000%	7
triangles	5	3	0	62.500%	37.500%	0.000%	8
constructions	4	4	0	50.000%	50.000%	0.000%	8
circles	5	3	0	62.500%	37.500%	0.000%	8
geometric solids	4	4	0	50.000%	50.000%	0.000%	8
area	5	3	0	62.500%	37.500%	0.000%	8
volume locus	0	8	0	0.000%	100.000%	0.000%	8
coordinate geometry	1	7	0	12.500%	87.500%	0.000%	8
transformations	1	7	0	12.500%	87.500%	0.000%	8
SUB TOTAL	65	86	0	43.046%	56.954%	0.000%	151

TOPIC

Trigonometry — INVOLVEMENT — ITEM RESPONSE RATE

CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
trigonometry function	1	7	0	12.500%	87.500%	0.000%	8
graphs of functions	0	8	0	0.000%	100.000%	0.000%	8
inverse trigonometry functions	1	7	0	12.500%	87.500%	0.000%	8
equations	1	7	0	12.500%	87.500%	0.000%	8
complex numbers	0	8	0	0.000%	100.000%	0.000%	8
triangle solutions	3	5	0	37.500%	62.500%	0.000%	8
vectors	0	8	0	0.000%	100.000%	0.000%	8
functional properitie	0	8	0	0.000%	100.000%	0.000%	8
SUB TOTAL	6	58	0	9.375%	90.625%	0.000%	64

TOPIC

Math Functions — INVOLVEMENT — ITEM RESPONSE RATE

TABLE 4 CON'T

CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
linear functions	3	5	0	37.500%	62.500%	0.000%	8
quadratic functions	1	7	0	12.500%	87.500%	0.000%	8
cubic functions	3	5	0	37.500%	62.500%	0.000%	8
polynomic functions	0	8	0	0.000%	100.000%	0.000%	8
rational functions	0	8	0	0.000%	100.000%	0.000%	8
absolute value functions	0	8	0	0.000%	100.000%	0.000%	8
greatest integer functions	0	8	0	0.000%	100.000%	0.000%	8
logarithmic functions	0	8	0	0.000%	100.000%	0.000%	8
exponential functions	0	8	0	0.000%	100.000%	0.000%	8
inverse functions	0	8	0	0.000%	100.000%	0.000%	8
circular &/or trig-nometric functions	1	7	0	12.500%	87.500%	0.000%	8
graphs of functions	0	8	0	0.000%	100.000%	0.000%	8
mathematical inductio	0	8	0	0.000%	100.000%	0.000%	8
SUB TOTAL	8	96	0	7.692%	92.308%	0.000%	104

TOPICS	YES	NO	RELATE	Y %	N %	RE %	TOTAL
FUNDAMENTAL MATH	76	34	3	67.26%	30.09%	2.65%	113
GENERAL MATH	27	34	3	42.19%	53.13%	4.69%	64
ALGEBRA	49	218	5	18.01%	80.15%	1.84%	272
GEOMETRY	65	86	0	43.05%	56.95%	0.00%	151
TRIGONOMETRY	6	58	0	9.38%	90.63%	0.00%	64
MATH FUNCTIONS	8	96	0	7.69%	92.31%	0.00%	104
TOTAL	231	526	11	30.08%	68.49%	1.43%	768

TABLE 5

ELECTRICITY/ELECTRONICS

TOPIC

Fundamental Math	INVOLVEMENT			ITEM RESPONSE RATE			
CONTENT ITEMS	YES	NO	RELATE	Y %	N %	RE %	TOTAL
basic integer math	6	0	3	66.667%	0.000%	33.333%	9
prime factorization	2	5	2	22.222%	55.556%	22.222%	9
greatest common divis	4	2	3	44.444%	22.222%	33.333%	9
fractions	5	2	2	55.556%	22.222%	22.222%	9
decimals	7	0	2	77.778%	0.000%	22.222%	9
rational & irrational numbers	1	7	1	11.111%	77.778%	11.111%	9
least common multiple	4	4	1	44.444%	44.444%	11.111%	9
proportions	7	1	1	77.778%	11.111%	11.111%	9
percentage	6	1	3	60.000%	10.000%	30.000%	10
interest	3	6	0	33.333%	66.667%	0.000%	9
metric system	6	1	3	60.000%	10.000%	30.000%	10
conversion within a system	7	1	1	77.778%	11.111%	11.111%	9
area of simple plane	4	4	1	44.444%	44.444%	11.111%	9
volume of simple solids	2	7	0	22.222%	77.778%	0.000%	9
SUB TOTAL	64	41	23	50.000%	32.031%	17.969%	128

TOPIC

General Math	INVOLVEMENT			ITEM RESPONSE RATEime)			
CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL %
metric system	5	2	2	55.556%	22.222%	22.222%	9
shop mathematics	7	1	1	77.778%	11.111%	11.111%	9
elementary business math	3	5	1	33.333%	55.556%	11.111%	9
simple geometric							

construction	3	6	0	33.333%	66.667%	0.000%	9
reading & constructing graphs	6	3	0	66.667%	33.333%	0.000%	9
rectangular coordinat	2	7	0	22.222%	77.778%	0.000%	9
indirect measurment	2	6	1	22.222%	66.667%	11.111%	9
elementary probabilit	0	9	0	0.000%	100.000%	0.000%	9
SUB TOTAL	28	39	5	38.889%	54.167%	6.944%	72

TOPIC

Algebra

	INVOLVEMENT			ITEM RESPONSE RATE			
CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
meaning of variable	6	2	1	66.667%	22.222%	11.111%	9
use of variable in formula	8	1	0	88.889%	11.111%	0.000%	9
use of variable in applied situation	5	3	1	55.556%	33.333%	11.111%	9
number systems	4	3	2	44.444%	33.333%	22.222%	9
number theory	4	4	1	44.444%	44.444%	11.111%	9
symbols	6	1	2	66.667%	11.111%	22.222%	9
algebraic expressions	6	2	1	66.667%	22.222%	11.111%	9
equations	7	2	0	77.778%	22.222%	0.000%	9
inequalities	0	9	0	0.000%	100.000%	0.000%	9
polynomials (add,sub., multip.,divid)	3	4	2	33.333%	44.444%	22.222%	9
real number systems	4	2	3	44.444%	22.222%	33.333%	9
relations & functions	3	5	1	33.333%	55.556%	11.111%	9
exponents	5	3	2	50.000%	30.000%	20.000%	10
arithmetic of radical expressions	2	7	0	22.222%	77.778%	0.000%	9
factoring polynomials	1	6	3	10.000%	60.000%	30.000%	10
system of equations	3	4	2	33.333%	44.444%	22.222%	9
quadratic equations	0	6	3	0.000%	66.667%	33.333%	9
graphs	5	3	1	55.556%	33.333%	11.111%	9

positive & negative numbers	8	0	1	88.889%	0.000%	11.111%	9
mathematical sentence	4	3	2	44.444%	33.333%	22.222%	9
linear equations: one and two variables	6	2	1	66.667%	22.222%	11.111%	9
algebraic fractions	2	4	3	22.222%	44.444%	33.333%	9
exponents & radicals	4	3	2	44.444%	33.333%	22.222%	9
simultaneous equations & matrices	1	8	0	11.111%	88.889%	0.000%	9
sets & equations	1	7	1	11.111%	77.778%	11.111%	9
functions & relations	3	5	1	33.333%	55.556%	11.111%	9
algebraic functions	5	3	1	55.556%	33.333%	11.111%	9
exponential & log-arithmic functions	4	3	2	44.444%	33.333%	22.222%	9
trigonometric function of angles	4	4	1	44.444%	44.444%	11.111%	9
trigonometric function of real numbers	1	7	1	11.111%	77.778%	11.111%	9
analytic geometry	1	8	0	11.111%	88.889%	0.000%	9
conic sections	0	9	0	0.000%	100.000%	0.000%	9
sequences & series	0	7	2	0.000%	77.778%	22.222%	9
Binomial Theorem	0	9	0	0.000%	100.000%	0.000%	9
SUB TOTAL	116	149	43	37.662%	48.377%	13.961%	308

TOPIC

Geometry — INVOLVEMENT — ITEM RESPONSE RATE

CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
points	1	6	2	11.111%	66.667%	22.222%	9
lines	2	3	4	22.222%	33.333%	44.444%	9
planes	1	5	3	11.111%	55.556%	33.333%	9
planes figures	2	5	2	22.222%	55.556%	22.222%	9
area & perimeter of plane figures	1	6	2	11.111%	66.667%	22.222%	9
congruence	0	8	1	0.000%	88.889%	11.111%	9

TABLE 5 CON'T

similarity	1	7	1	11.111%	77.778%	11.111%	9
volume & surface area of solids	4	4	1	44.444%	44.444%	11.111%	9
construction & measurement	4	2	3	44.444%	22.222%	33.333%	9
inductive & deductive reasoning	3	4	2	33.333%	44.444%	22.222%	9
angles	6	2	1	66.667%	22.222%	11.111%	9
triangles	6	2	1	66.667%	22.222%	11.111%	9
constructions	3	5	1	33.333%	55.556%	11.111%	9
circles	6	3	0	66.667%	33.333%	0.000%	9
geometric solids	1	8	0	11.111%	88.889%	0.000%	9
area	4	3	2	44.444%	33.333%	22.222%	9
volume locus	0	8	1	0.000%	88.889%	11.111%	9
coordinate geometry	0	6	3	0.000%	66.667%	33.333%	9
transformations	1	8	0	11.111%	88.889%	0.000%	9
SUB TOTAL	46	95	30	26.901%	55.556%	17.544%	171

TOPIC

Trigonometry

CONTENT ITEMS	INVOLVEMENT YES	NO	RELATED	ITEM RESPONSE RATE Y %	N %	RE %	TOTAL
trigonometry function	2	6	1	22.222%	66.667%	11.111%	9
graphs of functions	1	7	0	12.500%	87.500%	0.000%	8
inverse trigonometry functions	1	8	0	11.111%	88.889%	0.000%	9
equations	2	6	1	22.222%	66.667%	11.111%	9
complex numbers	1	7	0	12.500%	87.500%	0.000%	8
triangle solutions	4	4	1	44.444%	44.444%	11.111%	9
vectors	4	3	2	44.444%	33.333%	22.222%	9
functional properitie	3	5	1	33.333%	55.556%	11.111%	9
SUB TOTAL	18	46	6	25.714%	65.714%	8.571%	70

TOPIC

TABLE 5 CON'T

Math Functions	INVOLVEMENT			ITEM RESPONSE RATE			
CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
linear functions	2	7	0	22.222%	77.778%	0.000%	9
quadratic functions	1	8	0	11.111%	88.889%	0.000%	9
cubic functions	3	5	1	33.333%	55.556%	11.111%	9
polyanomic functions	0	8	1	0.000%	88.889%	11.111%	9
rational functions	0	8	1	0.000%	88.889%	11.111%	9
absolute value functions	2	7	0	22.222%	77.778%	0.000%	9
greatest integer functions	0	8	1	0.000%	88.889%	11.111%	9
logarithmic functions	2	5	2	22.222%	55.556%	22.222%	9
exponential functions	2	7	0	22.222%	77.778%	0.000%	9
inverse functions	2	6	1	22.222%	66.667%	11.111%	9
circular &/or trig-nometric functions	4	4	1	44.444%	44.444%	11.111%	9
graphs of functions	2	7	0	22.222%	77.778%	0.000%	9
mathematical inductio	0	9	0	0.000%	100.000%	0.000%	9
SUB TOTAL	20	89	8	17.094%	76.068%	6.838%	117

TOPICS	YES	NO	RELATE	Y %	N %	RE %	TOTAL
FUNDAMENTAL MATH	64	41	23	50.00%	32.03%	17.97%	128
GENERAL MATH	28	39	5	38.89%	54.17%	6.94%	72
ALGEBRA	116	149	43	37.66%	48.38%	13.96%	308
GEOMETRY	46	95	30	26.90%	55.56%	17.54%	171
TRIGONOMETRY	18	46	6	25.71%	65.71%	8.57%	70
MATH FUNCTIONS	20	89	8	17.09%	76.07%	247.01%	117
TOTAL	292	459	115	33.72%	53.00%	13.28%	866

TABLE 6 CON'T

TABLE 6

MACHINE SHOP

TOPIC

Fundamental Math	INVOLVEMENT			ITEM RESPONSE RATE			
CONTENT ITEMS	YES	NO	RELATE	Y %	N %	RE %	TOTAL
basic integer math	8	2	1	72.727%	18.182%	9.091%	11
prime factorization	4	4	3	36.364%	36.364%	27.273%	11
greatest common divis	9	1	1	81.818%	9.091%	9.091%	11
fractions	10	0	1	90.909%	0.000%	9.091%	11
decimals	10	0	1	90.909%	0.000%	9.091%	11
rational & irrational numbers	5	5	1	45.455%	45.455%	9.091%	11
least common multiple	5	4	2	45.455%	36.364%	18.182%	11
proportions	6	4	1	54.545%	36.364%	9.091%	11
percentage	8	2	1	72.727%	18.182%	9.091%	11
interest	3	6	1	30.000%	60.000%	10.000%	10
metric system	10	1	0	90.909%	9.091%	0.000%	11
conversion within a system	9	2	0	81.818%	18.182%	0.000%	11
area of simple plane	5	5	1	45.455%	45.455%	9.091%	11
volume of simple solids	4	6	1	36.364%	54.545%	9.091%	11
SUB TOTAL	96	42	15	62.745%	27.451%	9.804%	153

TOPIC

General Math	INVOLVEMENT			ITEM RESPONSE RATEime)			
CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL %
metric system	10	1	0	90.909%	9.091%	0.000%	11
shop mathematics	11	0	0	100.000%	0.000%	0.000%	11
elementary business math	1	9	0	10.000%	90.000%	0.000%	10
simple geometric							

TABLE 6 CON'T

construction	9	2	1	75.000%	16.667%	8.333%	12
reading & constructing graphs	1	10	0	9.091%	90.909%	0.000%	11
rectangular coordinat	9	2	0	81.818%	18.182%	0.000%	11
indirect measurment	6	4	0	60.000%	40.000%	0.000%	10
elementary probabilit	0	9	1	0.000%	90.000%	10.000%	10
SUB TOTAL	47	37	2	54.651%	43.023%	2.326%	86

TOPIC

Algebra

	INVOLVEMENT			ITEM RESPONSE RATE			
CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
meaning of variable	4	7	0	36.364%	63.636%	0.000%	11
use of variable in formula	4	7	1	33.333%	58.333%	8.333%	12
use of variable in applied situation	2	9	1	16.667%	75.000%	8.333%	12
number systems	2	9	1	16.667%	75.000%	8.333%	12
number theory	0	10	1	0.000%	90.909%	9.091%	11
symbols	3	8	0	27.273%	72.727%	0.000%	11
algebraic expressions	4	7	1	33.333%	58.333%	8.333%	12
equations	5	6	1	41.667%	50.000%	8.333%	12
inequalities	1	10	1	8.333%	83.333%	8.333%	12
polynomials (add,sub., multip.,divid)	2	9	1	16.667%	75.000%	8.333%	12
real number systems	0	11	0	0.000%	100.000%	0.000%	11
relations & functions	0	11	0	0.000%	100.000%	0.000%	11
exponents	2	9	0	18.182%	81.818%	0.000%	11
arithmetic of radical expressions	2	9	0	18.182%	81.818%	0.000%	11
factoring polynomials	0	11	0	0.000%	100.000%	0.000%	11
system of equations	0	10	1	0.000%	90.909%	9.091%	11
quadratic equations	0	11	0	0.000%	100.000%	0.000%	11
graphs	1	10	0	9.091%	90.909%	0.000%	11

positive & negative numbers	4	7	0	36.364%	63.636%	0.000%	11
mathematical sentence	2	9	0	18.182%	81.818%	0.000%	11
linear equations: one and two variables	1	10	1	8.333%	83.333%	8.333%	12
algebraic fractions	3	8	1	25.000%	66.667%	8.333%	12
exponents & radicals	2	9	0	18.182%	81.818%	0.000%	11
simultaneous equations & matrices	0	10	1	0.000%	90.909%	9.091%	11
sets & equations	1	10	0	9.091%	90.909%	0.000%	11
functions & relations	0	10	1	0.000%	90.909%	9.091%	11
algebraic functions	2	9	0	18.182%	81.818%	0.000%	11
exponential & log-arithmic functions	1	9	0	10.000%	90.000%	0.000%	10
trigonometric function of angles	10	1	0	90.909%	9.091%	0.000%	11
trigonometric function of real numbers	7	9	0	43.750%	56.250%	0.000%	16
analytic geometry	1	10	0	9.091%	90.909%	0.000%	11
conic sections	0	11	0	0.000%	100.000%	0.000%	11
sequences & series	0	11	0	0.000%	100.000%	0.000%	11
Binomial Theorem	0	11	0	0.000%	100.000%	0.000%	11
SUB TOTAL	66	308	13	17.054%	79.587%	3.359%	387

TOPIC

Geometry	INVOLVEMENT			ITEM RESPONSE RATE			
CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
points	9	2	0	81.818%	18.182%	0.000%	11
lines	9	2	0	81.818%	18.182%	0.000%	11
planes	8	3	0	72.727%	27.273%	0.000%	11
planes figures	7	3	1	63.636%	27.273%	9.091%	11
area & perimeter of plane figures	5	4	1	50.000%	40.000%	10.000%	10
congruence	2	9	0	18.182%	81.818%	0.000%	11

TABLE 6 CON'T

similarity	2	9	0	18.182%	81.818%	0.000%	11
volume & surface area of solids	3	5	2	30.000%	50.000%	20.000%	10
construction & measurement	7	2	0	77.778%	22.222%	0.000%	9
inductive & deductive reasoning	1	10	0	9.091%	90.909%	0.000%	11
angles	11	0	0	100.000%	0.000%	0.000%	11
triangles	10	1	0	90.909%	9.091%	0.000%	11
constructions	5	6	0	45.455%	54.545%	0.000%	11
circles	10	1	0	90.909%	9.091%	0.000%	11
geometric solids	6	4	1	54.545%	36.364%	9.091%	11
area	5	6	0	45.455%	54.545%	0.000%	11
volume locus	0	10	1	0.000%	90.909%	9.091%	11
coordinate geometry	2	9	0	18.182%	81.818%	0.000%	11
transformations	0	11	0	0.000%	100.000%	0.000%	11
SUB TOTAL	102	97	6	49.756%	47.317%	2.927%	205

TOPIC

Trigonometry — INVOLVEMENT — ITEM RESPONSE RATE

CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
trigonometry function	9	1	1	81.818%	9.091%	9.091%	11
graphs of functions	0	11	0	0.000%	100.000%	0.000%	11
inverse trigonometry functions	1	10	0	9.091%	90.909%	0.000%	11
equations	4	7	0	36.364%	63.636%	0.000%	11
complex numbers	2	9	0	18.182%	81.818%	0.000%	11
triangle solutions	9	2	0	81.818%	18.182%	0.000%	11
vectors	3	8	0	27.273%	72.727%	0.000%	11
functional properitie	3	8	0	27.273%	72.727%	0.000%	11
SUB TOTAL	31	56	1	35.227%	63.636%	1.136%	88

TOPIC

TABLE 6 CON'T

Math Functions	INVOLVEMENT			ITEM RESPONSE RATE			
CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
linear functions	5	6	0	45.455%	54.545%	0.000%	11
quadratic functions	0	11	0	0.000%	100.000%	0.000%	11
cubic functions	3	8	0	27.273%	72.727%	0.000%	11
polyanomic functions	1	10	0	9.091%	90.909%	0.000%	11
rational functions	0	11	0	0.000%	100.000%	0.000%	11
absolute value functions	1	10	0	9.091%	90.909%	0.000%	11
greatest integer functions	0	10	0	0.000%	100.000%	0.000%	10
logarithmic functions	3	8	0	27.273%	72.727%	0.000%	11
exponential functions	1	10	0	9.091%	90.909%	0.000%	11
inverse functions	1	10	0	9.091%	90.909%	0.000%	11
circular &/or trig-nometric functions	8	3	0	72.727%	27.273%	0.000%	11
graphs of functions	1	10	0	9.091%	90.909%	0.000%	11
mathematical inductio	1	10	0	9.091%	90.909%	0.000%	11
SUB TOTAL	25	117	0	17.606%	82.394%	0.000%	142

TOPICS	YES	NO	RELATE	Y %	N %	RE %	TOTAL
FUNDAMENTAL MATH	96	42	15	62.75%	27.45%	9.80%	153
GENERAL MATH	47	37	2	54.65%	43.02%	2.33%	86
ALGEBRA	66	308	13	17.05%	79.59%	3.36%	387
GEOMETRY	102	97	6	49.76%	47.32%	2.93%	205
TRIGONOMETRY	31	56	1	35.23%	63.64%	1.14%	88
MATH FUNCTIONS	25	117	0	17.61%	82.39%	0.00%	142
TOTAL	367	657	37	34.59%	61.92%	3.49%	1061

TABLE 7

OVERALL

TOPIC

Fundamental Math	INVOLVEMENT			ITEM RESPONCE RATE			
CONTENT ITEMS	YES	NO	RELATE	Y %	N %	RE %	TOTAL
basic integer math	20	3	5	71.429%	10.714%	17.857%	28
prime factorization	11	12	6	37.931%	41.379%	20.690%	29
greatest common divis	20	4	4	71.429%	14.286%	14.286%	28
fractions	23	2	3	82.143%	7.143%	10.714%	28
decimals	25	0	3	89.286%	0.000%	10.714%	28
rational & irrational numbers	9	17	2	32.143%	60.714%	7.143%	28
least common multiple	14	11	3	50.000%	39.286%	10.714%	28
proportions	20	6	2	71.429%	21.429%	7.143%	28
percentage	21	4	4	72.414%	13.793%	13.793%	29
interest	10	17	1	35.714%	60.714%	3.571%	28
metric system	17	8	4	58.621%	27.586%	13.793%	29
conversion within a system	19	8	1	67.857%	28.571%	3.571%	28
area of simple plane	16	10	2	57.143%	35.714%	7.143%	28
volume of simple solids	8	16	1	32.000%	64.000%	4.000%	25
SUB TOTAL	233	118	41	59.439%	30.102%	10.459%	392

TOPIC

General Math	INVOLVEMENT			ITEM RESPONSE RATE			
CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL %
metric system	17	7	3	62.963%	25.926%	11.111%	27
shop mathematics	25	2	1	89.286%	7.143%	3.571%	28
elementary business math	7	20	1	25.000%	71.429%	3.571%	28
simple geometric							

TABLE 7 CON'T

construction	17	11	1	58.621%	37.931%	3.448%	29
reading & constructing graphs	10	16	0	38.462%	61.538%	0.000%	26
rectangular coordinat	14	13	1	50.000%	46.429%	3.571%	28
indirect measurment	10	15	2	37.037%	55.556%	7.407%	27
elementary probabilit	1	27	0	3.571%	96.429%	0.000%	28
SUB TOTAL	101	111	9	45.701%	50.226%	4.072%	221

TOPIC

Algebra — INVOLVEMENT — ITEM RESPONSE RATE

CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
meaning of variable	10	16	3	34.483%	55.172%	10.345%	29
use of variable in formula	12	14	3	41.379%	48.276%	10.345%	29
use of variable in applied situation	8	18	3	27.586%	62.069%	10.345%	29
number systems	7	19	3	24.138%	65.517%	10.345%	29
number theory	5	21	2	17.857%	75.000%	7.143%	28
symbols	11	15	2	39.286%	53.571%	7.143%	28
algebraic expressions	13	14	2	44.828%	48.276%	6.897%	29
equations	16	12	1	55.172%	41.379%	3.448%	29
inequalities	2	25	1	7.143%	89.286%	3.571%	28
polynomials (add,sub., multip.,divid)	8	18	3	27.586%	62.069%	10.345%	29
real number systems	5	20	3	17.857%	71.429%	10.714%	28
relations & functions	5	22	1	17.857%	78.571%	3.571%	28
exponents	9	18	2	31.034%	62.069%	6.897%	29
arithmetic of radical expressions	5	23	0	17.857%	82.143%	0.000%	28
factoring polynomials	2	24	2	7.143%	85.714%	7.143%	28
system of equations	5	20	2	18.519%	74.074%	7.407%	27
quadratic equations	1	24	3	3.571%	85.714%	10.714%	28
graphs	7	20	1	25.000%	71.429%	3.571%	28

positive & negative numbers	13	14	1	46.429%	50.000%	3.571%	28
mathematical sentence	9	17	2	32.143%	60.714%	7.143%	28
linear equations: one and two variables	8	19	2	27.586%	65.517%	6.897%	29
algebraic fractions	6	19	4	20.690%	65.517%	13.793%	29
exponents & radicals	7	19	2	25.000%	67.857%	7.143%	28
simultaneous equations & matrices	2	25	1	7.143%	89.286%	3.571%	28
sets & equations	3	24	1	10.714%	85.714%	3.571%	28
functions & relations	5	21	2	17.857%	75.000%	7.143%	28
algebraic functions	9	18	1	32.143%	64.286%	3.571%	28
exponential & log-arithmic functions	6	20	2	21.429%	71.429%	7.143%	28
trigonometric function of angles	16	11	1	57.143%	39.286%	3.571%	28
trigonometric function of real numbers	10	17	0	37.037%	62.963%	0.000%	27
analytic geometry	3	25	0	10.714%	89.286%	0.000%	28
conic sections	1	27	0	3.571%	96.429%	0.000%	28
sequences & series	1	25	2	3.571%	89.286%	7.143%	28
Binomial Theorem	0	27	0	0.000%	100.000%	0.000%	27
SUB TOTAL	230	671	58	23.983%	69.969%	6.048%	959

TOPIC

Geometry

	INVOLVEMENT			ITEM RESPONSE RATE			
CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
points	14	12	2	50.000%	42.857%	7.143%	28
lines	15	9	4	53.571%	32.143%	14.286%	28
planes	13	11	3	48.148%	40.741%	11.111%	27
planes figures	13	12	1	50.000%	46.154%	3.846%	26
area & perimeter of plane figures	10	14	3	37.037%	51.852%	11.111%	27
congruence	3	24	1	10.714%	85.714%	3.571%	28

TABLE 7 CON'T

similarity	5	22	1	17.857%	78.571%	3.571%	28
volume & surface area of solids	11	9	5	44.000%	36.000%	20.000%	25
construction & measurement	16	9	3	57.143%	32.143%	10.714%	28
inductive & deductive reasoning	6	20	2	21.429%	71.429%	7.143%	28
angles	23	3	1	85.185%	11.111%	3.704%	27
triangles	21	6	1	75.000%	21.429%	3.571%	28
constructions	12	15	1	42.857%	53.571%	3.571%	28
circles	21	7	0	75.000%	25.000%	0.000%	28
geometric solids	11	15	1	40.741%	55.556%	3.704%	27
area	14	12	2	50.000%	42.857%	7.143%	28
volume locus	0	26	2	0.000%	92.857%	7.143%	28
coordinate geometry	3	22	3	10.714%	78.571%	10.714%	28
transformations	2	26	0	7.143%	92.857%	0.000%	28
SUB TOTAL	213	274	36	40.727%	52.390%	6.883%	523

TOPIC

Trigonometry — INVOLVEMENT — ITEM RESPONSE RATE

CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
trigonometry function	12	14	2	42.857%	50.000%	7.143%	28
graphs of functions	1	26	0	3.704%	96.296%	0.000%	27
inverse trigonometry functions	3	25	0	10.714%	89.286%	0.000%	28
equations	7	20	1	25.000%	71.429%	3.571%	28
complex numbers	3	24	0	11.111%	88.889%	0.000%	27
triangle solutions	16	11	1	57.143%	39.286%	3.571%	28
vectors	7	19	2	25.000%	67.857%	7.143%	28
functional properitie	6	21	1	21.429%	75.000%	3.571%	28
SUB TOTAL	55	160	7	24.775%	72.072%	3.153%	222

TOPIC

TABLE 7 CON'T

Math Functions	INVOLVEMENT			ITEM RESPONSE RATE			
CONTENT ITEMS	YES	NO	RELATED	Y %	N %	RE %	TOTAL
linear functions	10	18	0	35.714%	64.286%	0.000%	28
quadratic functions	2	25	0	7.407%	92.593%	0.000%	27
cubic functions	9	18	1	32.143%	64.286%	3.571%	28
polyanomic functions	1	26	1	3.571%	92.857%	3.571%	28
rational functions	0	27	1	0.000%	96.429%	3.571%	28
absolute value functions	3	25	0	10.714%	89.286%	0.000%	28
greatest integer functions	0	26	1	0.000%	96.296%	3.704%	27
logarithmic functions	5	21	2	17.857%	75.000%	7.143%	28
exponential functions	3	25	0	10.714%	89.286%	0.000%	28
inverse functions	3	24	1	10.714%	85.714%	3.571%	28
circular &/or trig-nometric functions	19	14	1	55.882%	41.176%	2.941%	34
graphs of functions	3	25	0	10.714%	89.286%	0.000%	28
mathematical inductio	1	27	0	3.571%	96.429%	0.000%	28
SUB TOTAL	59	301	8	16.033%	81.793%	2.174%	368

TOPICS	YES	NO	RELATE	Y %	N %	RE %	TOTAL
FUNDAMENTAL MATH	233	118	41	59.44%	30.10%	10.46%	392
GENERAL MATH	101	111	9	45.70%	50.23%	4.07%	221
ALGEBRA	230	671	58	23.98%	69.97%	6.05%	959
GEOMETRY	213	274	36	40.73%	52.39%	6.88%	523
TRIGONOMETRY	55	160	7	24.77%	72.07%	3.15%	222
MATH FUNCTIONS	59	301	8	16.03%	81.79%	2.17%	368
TOTAL	891	1635	159	33.18%	60.89%	5.92%	2685

TABLE 8

RESPONSE RATE FOR INDIVIDUAL MATH SUBJECT/COURSES BY T & I PROGRAM AREA

T & I AREAS	OVERALL	CARPENTRY	E/E	MACHINE SHOP
MATH COURSE				
FM	69.90%	69.91%	67.97%	72.55%
GM	49.77%	46.88%	45.83%	56.98%
ALG	30.03%	19.85%	51.62%	20.41%
GEO	47.61%	43.05%	44.44%	52.69%
TRI	27.91%	9.38%	34.28%	36.37%
MF	18.20%	7.69%	23.92%	17.61%
TOTAL	39.10%	31.51%	47.00%	38.08%

Note: FM = Fundamental Math; GM = General Math; ALG = Algebra; GEO = Geometry; TRI = Trigonometry; MF = Math Functions.

TABLE 9

RESPONSE RATE FOR CONTENT ITEMS OF
MATH SUBJECT/COURSE BY T & I PROGRAM AREA

T & I AREAS		OVERALL		CARPENTRY		E/E		MACHINE SHOP	
CONTENT ITEMS (from table 1)		N	%	N	%	N	%	N	%
FM	14	11	78.5%	11	78.5%	10	71.42%	12	85.7
GM	8	4	50.%	4	50%	3	37.5%	5	62.5%
ALG	34	5	14.7%	1	3%	21	61.76%	1	3%
GEO	19	11	57.89%	12	63%	7	36.8%	11	57.89%
TRI	8	2	25%	0	0	2	25%	2	25%
MF	13	1	7.6%	0	0	1	7.6%	1	7.6%
TOTAL	96	34		28		44		32	
%			35.45%		29.1%		45.86%		22.98%

Note: FM = Fundamental Math; GM = General Math; ALG = algebra
GEO = Geometry; TRI = Trigonometry; MF = Math Function.

RECOMMENDATIONS & CONCLUSIONS

Conclusions

The following conclusions are drawn from the general findings of the survey efforts. When grouping YES responses with RELATE responses, a profile of the current involvement in each math subject/course area emerges. A level of 50% or greater involvement is accepted as significant instructional involvement on the part of vocational education programs (taken from table 8).

- o All three T & I areas exceed the 50% level involvement in the Fundamental Math course.
- o General Math ranges from a high of 56.98% in Machine Shop to a low of 45.83% in E/E.
- o E/E has a 51.62% involvement rate in Algebra, indicating significant instruction in this content area.
- o Machine Shop has a 52.69% involvement rate in Geometry, with a 56.98% in General Math, and a 72.55% in Fundamental Math content.
- o Carpentry reaches a 46.88% involvement rate in General Math.
- o Overall, all three areas combined, has a high of 69.90% in Fundamental Math to a low of 18.20% in Math Functions, with an average involvement of 39.10% for all math content.
- o The overall for each T & I area has a range of 47% for E/E to 31.51% for Carpentry.

The following conclusions are drawn from table 9 . Table 9 represents the findings from analyzing the T & I responses rate for each individual content item of the math subject/course area. These are given in simple counts and percentages. A response rate of 50% or higher is considered significant.

- o All T & I areas cover over 50% of content items in the Fundamental Math Course.

- o Carpentry and Machine Shop cover over 50% of General Math content items and Geometry content items.
- o E/E covers 61.76% of all Algebra topics.
- o Machine Shop covers 57.89% of Geometry Content.
- o The overall for each T & I area has a range of a high 45.86% for E/E to a low of 22.98% for Machine Shop in covering individual content items.

Recommendations

The following are recommendations drawn from the research findings reported herein.

- o A significant rate has been sighted in several math subjects now being addressed through vocational education programs. Therefore, grounds have been established to equate the math instruction in these selected T & I subjects for graduate credit consideration. This should focus on the math areas of Fundamental Math, Algebra, and Geometry.
- o Further study should be undertaken in expanded vocational education subjects in order to gain additional understanding of such math involvement.
- o A survey based upon science content should be undertaken in the three T & I areas of this study. More time and resources are needed to adequately approach science content.
- o Follow-up study on this research project should be undertaken. This could be started during the Fall of 1986.

APPENDIX A

APPLIED MATH & SCIENCE LEVELS
UTILIZED IN TRADE & INDUSTRIAL
VOCATIONAL EDUCATION

This survey is designed to measure the level of instruction of math and science content in selected Industrial Education programs. Your participation in this survey is greatly appreciated.

PROCEDURE:

You will find below a listing of content items used to guide instruction in several math & science topics offered in Secondary Education programs throughout Kentucky's public schools. Please review this list and indicate your programs involvement with the appropriate topics. If any content item is not taught directly in your course, but is a part of instruction obtained in your program through a supporting course mark it under the **related** column and identify this course under **comment**. You may find content items repeated throughout this survey. Please mark the content items you are involved with as many times as they appear. Indicate your best estimate of time spent on the item under Comment.

THANK YOU.

NAME (OPTIONAL): _____ SUBJECT TAUGHT: _____

SCHOOL (OPTIONAL):_____ GRADE/PROGRAM LEVEL: _____

TOPIC

Fundamental Math	INVOLVEMENT			COMMENT (est. time on item)
CONTENT ITEMS	YES	NO	RELATE	
basic integer math	___	___	___	_____
prime factorization	___	___	___	_____
greatest common divisor	___	___	___	_____
fractions	___	___	___	_____
decimals	___	___	___	_____
rational & irrational numbers	___	___	___	_____
least common multiple	___	___	___	_____

proportions	___	___	___	_____
percentage	___	___	___	_____
interest	___	___	___	_____
metric system	___	___	___	_____
conversion within a system	___	___	___	_____
area of simple plane	___	___	___	_____
volume of simple solids	___	___	___	_____

TOPIC

General Math	INVOLVEMENT			COMMENT (est. time)
CONTENT ITEMS	YES	NO	RELATED	
metric system	___	___	___	_____
shop mathematics	___	___	___	_____
elementary business math	___	___	___	_____
simple geometric construction	___	___	___	_____
reading & constructing graphs	___	___	___	_____
rectangular coordinate	___	___	___	_____
indirect measurment	___	___	___	_____
elementary probability	___	___	___	_____

TOPIC

Algebra	INVOLVEMENT			COMMENT (est. time)
CONTENT ITEMS	YES	NO	RELATED	
meaning of variable	___	___	___	_____
use of variable in formula	___	___	___	_____

use of variable in applied situation	___	___	___	_____
number systems	___	___	___	_____
number theory	___	___	___	_____
symbols	___	___	___	_____
algebraic expressions	___	___	___	_____
equations	___	___	___	_____
inequalities	___	___	___	_____
polynomials (add,sub., multip.,divid)	___	___	___	_____
real number systems	___	___	___	_____
relations & functions	___	___	___	_____
exponents	___	___	___	_____
arithmetic of radical expressions	___	___	___	_____
factoring polynomials	___	___	___	_____
system of equations	___	___	___	_____
quadratic equations	___	___	___	_____
graphs	___	___	___	_____
positive & negative numbers	___	___	___	_____
mathematical sentences	___	___	___	_____
linear equations: one and two variables	___	___	___	_____
algebraic fractions	___	___	___	_____
exponents & radicals	___	___	___	_____
simultaneous equations & matrices	___	___	___	_____
sets & equations	___	___	___	_____
functions & relations	___	___	___	_____
algebraic functions	___	___	___	_____

exponential & logarithmic functions	___	___	___	_____
trigonometric function of angles	___	___	___	_____
trigonometric function of real numbers	___	___	___	_____
analytic geometry	___	___	___	_____
conic sections	___	___	___	_____
sequences & series	___	___	___	_____
Binomial Theorem	___	___	___	_____

TOPIC

Geometry	INVOLVEMENT			COMMENT (est. time)
CONTENT ITEMS	YES	NO	RELATED	
points	___	___	___	_____
lines	___	___	___	_____
planes	___	___	___	_____
planes figures	___	___	___	_____
area & perimeter of plane figures	___	___	___	_____
congruence	___	___	___	_____
similarity	___	___	___	_____
volume & surface area of solids	___	___	___	_____
construction & measurement	___	___	___	_____
inductive & deductive reasoning	___	___	___	_____
angles	___	___	___	_____
triangles	___	___	___	_____
constructions	___	___	___	_____
circles	___	___	___	_____
geometric solids	___	___	___	_____

area	___	___	___	_____
volume locus	___	___	___	_____
coordinate geometry	___	___	___	_____
transformations	___	___	___	_____

TOPIC

Trigonometry	INVOLVEMENT			COMMENT (est. time)
CONTENT ITEMS	YES	NO	RELATED	
trigonometry functions	___	___	___	_____
graphs of functions	___	___	___	_____
inverse trigonometry functions	___	___	___	_____
equations	___	___	___	_____
complex numbers	___	___	___	_____
triangle solutions	___	___	___	_____
vectors	___	___	___	_____
functional properities	___	___	___	_____

TOPIC

Math Functions	INVOLVEMENT			COMMENT (est. time)
CONTENT ITEMS	YES	NO	RELATED	
linear functions	___	___	___	_____
quadratic functions	___	___	___	_____
cubic functions	___	___	___	_____
polyanomic functions	___	___	___	_____
rational functions	___	___	___	_____
absolute value functions	___	___	___	_____

greatest integer functions	___	___	___	_____
logarithmic functions	___	___	___	_____
exponential functions	___	___	___	_____
inverse functions	___	___	___	_____
circular &/or trig-nometric functions	___	___	___	_____
graphs of functions	___	___	___	_____
mathematical induction	___	___	___	_____

****

PLEASE INDICATE BELOW ANY CONTENT ITEMS OF TOPICS WHICH YOU FEEL ARE ADDRESSED IN THE INSTRUCTION OF YOUR PROGRAM THAT DID NOT APPEAR ON THIS LISTING.

_____

_____

_____

_____

_____

****

Please list below the books, pamphlets, handouts, etc. that are used in your instruction of these content items.

_____

_____

_____

_____

_____

THANK YOUR FOR YOUR HELP.

APPENDIX B

NORTHERN KENTUCKY UNIVERSITY
DEPARTMENT OF TECHNOLOGY AND OCCUPATIONAL EDUCATION
Highland Heights, Kentucky 41076

Dear Industrial Education Teacher:

Several weeks ago I contacted your program in hopes of soliciting your input to an important survey I am conducting in cooperation with the Office of Vocational Education, Kentucky Department of Education. This is a follow up on that initial correspondence.

The cover letter of the first mailing, which I have enclosed a copy of, explains that we are attempting to identify the level equivalence between Vocational-Technical instruction with that of Public School instruction in the areas of Math & Science. It is important to ask for your assistance in this survey in order that we develop an accurate representation of the actual practices in Vocational Education.

Please take a moment to complete the enclosed survey and return it to my attention. Your help will insure the success of our efforts to establish the equivalence factor. A deadline of September 20th has been set for the completion of this project.

Many thanks for your time.

Sincerely

_____
Dr. James R. Gray

DEPARTMENT OF TECHNOLOGY & OCCUPATIONAL EDUCATION
NORTHERN KENTUCKY UNIVERSITY
HIGHLAND HEIGHTS, KENTUCKY

Dear Industrial Education Teacher:

Currently I am conducting a survey of selected Trade & Industrial Vocational teachers in Kentucky to determine the level of applied math and science being taught. The subject you teach has been included in this project. As you are undoubtedly aware, your subject requires a great deal of math concepts and science prinicples in its mastery. For this reason I am asking for your help.

My survey project is designed to measure the level of instruction in these two areas to; first identify the level which these disciplines are approached, second to identifiy the methods used to instruct in them, third to document the instructional time spent on each, fourth to establish the equivalency between Vocational School instruction and Secondary School instruction inorder to apply for high school graduation credit.

Please take a few minutes to complete the enclosed survey and return it in the self addressed, stamped envelope. Your help is greatly appreciated in this regard.

I will keep you informed of the results of this project. Thank you.

Sincerely

_____
Dr. James R. Gray
Dept of Technology & Occupational Education